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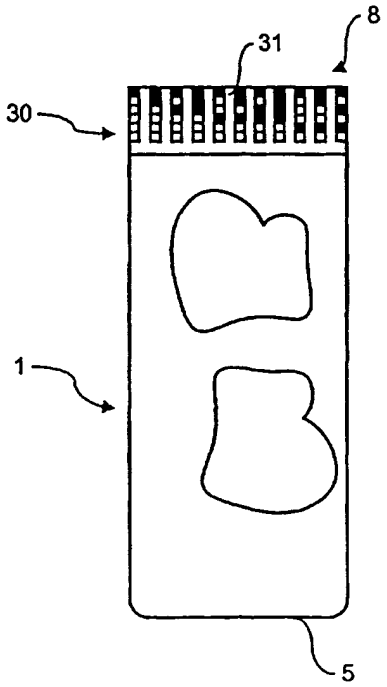
(54) Title: RELATIVE ORIENTATION OF BODIES AND ASSOCIATED APPARATUS



(57) Abstract: A portion of a coded region (31) of a body (1) is sampled and the code sample is compared with memory stored code data. On the basis of the comparison between the sampled and stored code data an orientation correction is determined and the relative position of the cylindrical body (1) and associated apparatus is reorientated to a datum situation.

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Relative Orientation of Bodies and Associated Apparatus

The present invention relates to relative orientation of bodies and associated apparatus in a manufacturing process. In particular the invention relates to relative orientation of containers or generally cylindrical bodies, particularly thin walled metallic cylindrical bodies (such as aluminium containers) for embossing, marking or the like.

It is known to be desirable to deform by embossing or the like the external cylindrical walls of metallic containers such as aluminium containers. In particular attempts have been made to emboss the walls of containers at predetermined locations to complement the printed designs on the external surfaces of such containers. In such techniques it is important to coordinate the embossing tooling with the preprinted design on the container wall. Prior art proposals disclose the use of a scanning system to identify the position of the container relative to a datum position and reorientation of the container to conform to the datum position.

An improved arrangement has now been devised.

According to a first aspect, the present invention provides a method of relative orientation of a body (particularly a container or generally cylindrical body) and associated apparatus, the method comprising sampling a portion of a coded region of the body, comparing the sampled code portion to memory stored code data, determining the orientation correction to reorientate the relative position

of the cylindrical body and the associated apparatus to a datum situation.

Beneficially, the coded region of the typically cylindrical body comprises a code carrying zone comprising one or more code strings each code string comprising a plurality of data points, the data points indicating one or other of contrasting data indicia.

According to a further aspect, the invention provides a re-orientation system for co-ordination of a body (such as a container or cylindrical body) and associated body processing apparatus, the system comprising:

a sampling arrangement for sampling a coded region of the body; and

a processor arranged to process sampled code data comparing to memory stored code data and produce a correction output to re-orientate the body and body processing apparatus to a datum situation.

According to a further aspect, the invention provides a container or generally cylindrical body having a coded region comprising one or more code strings each code string comprising a plurality of data points, the data points indicating one or other of contrasting data indicia.

Preferred features of the invention are presented in the appended claims. Advantages provided by preferred features of the invention will be readily apparent from the

following description.

The invention will now be further described in a specific embodiment, by way of example only, and with reference to the accompanying drawings, in which:

Figure 1 is a flow diagram of a process according to the invention;

Figure 2 is a view of a container to be operated upon in accordance with the invention;

Figure 3 is a side view of the container of figure 2 in a finish formed state;

Figure 4 is a 360 degree view of a positional code in accordance with the invention;

Figure 5 is a schematic side view of apparatus in accordance with the invention;

Figures 6 and 7 are half plan views of apparatus components of figure 5;

Figures 8,9 and 10 correspond to the views of figures 5,6 and 7 with components in a different operational orientation;

Figure 11 is a schematic close up sectional view of the apparatus of the preceding figures in a first stage of the forming process;

Figure 11a is a detail view of the forming tools and the container wall in the stage of operation of figure 11;

Figures 12, 12a to 16,16a correspond to the views of figures 11 and 11a.

Referring to the drawings the apparatus and technique is directed to plastically deforming (embossing or debossing) the circumferential wall of an aluminium container 1 at a predetermined position relative to a preprinted decorative design on the external container wall.

In the embodiment shown in the drawings, a design 50 comprising a series of three axially spaced arc grooves is to be embossed at 180 degree opposed locations on the container wall (see figure 16a). For aesthetic reasons it is important that the location at which the design 50 is embossed is coordinated with the printed design on the container 1 wall. Coordination of the container 1 axial orientation with the tooling to effect deformation is therefore crucial.

Referring to figures 5 to 7 the forming apparatus 2 comprises a vertically orientated rotary table 3 operated to rotate (about a horizontal axis) in an indexed fashion to successively rotationally advanced locations. Spaced around the periphery of table 3 are a series of container holding stations comprising clamping chucks 4. Containers are delivered in sequence to the table in random axial rotational orientations, each being received in a respective chuck 4, securely clamped about the container

base 5.

A vertically orientated forming table 6 faces the rotary table 3 and carries a series of deformation tools at spaced tooling stations 7. Following successive rotary index movements of rotary table 3, table 6 is advanced from a retracted position (figure 5) to an advanced position (figure 8). In moving to the advanced position the respective tools at tooling stations 7 perform forming operations on the container circumferential walls proximate their respective open ends 8. Successive tooling stations 7 perform successive degrees of deformation in the process. This process is well known and used in the prior art and is frequently known as necking. Necked designs of various neck/shoulder profiles such as that shown in figure 3 can be produced.

Necking apparatus typically operates at speeds of up to 200 containers per minute giving a typical working time duration at each forming station in the order of 0.3 seconds. In this time, it is required that the tooling table 6 moves axially to the advanced position, the tooling at a respective station contacts a respective container and deforms one stage in the necking process, and the tooling table 6 is retracted.

In accordance with the invention, in addition to the necking/shoulder-forming tooling at stations 7, the tooling table carries embossing toling 10 at an embossing station 9. The embossing tooling (shown most clearly in figures 11 to 16) comprises inner forming tool parts 11a, 11b of

respective arms 11 of an expandible internal tool mandrel 15. Tool parts 11a, 11b carry respective female embossing formations 12.

The embossing tooling 10 also includes a respective outer tool arrangement including respective arms 13 carrying tooling parts 13a, 13b having complementary male embossing formations 14. In moving to the table 7 advanced position the respective internal tool parts 11a, 11b are positioned internally of the container spaced adjacently the container 1 wall; the respective external tool parts 13a,13b are positioned externally of the container spaced adjacently the container 1 wall.

The internal mandrel 15 is expandible to move the tooling parts 11a , 11b to a relatively spaced apart position in which they abut the internal wall of the container 1 (see figure 12) from the collapsed position shown in figure 11 (tools 11a, 11b spaced from the internal wall of the container 1). An elongate actuator rod 16 is movable in a longitudinal direction to effect expansion and contraction of the mandrel 15 and consequent movement apart and toward one another of the tool parts 11a,11b. A the cam head portion 17 of the actuator rod 16 effects expansion of the mandrel 15 as the actuator rod 16 moves in the direction of arrow A. The cam head portion 17 acts against sloping wedge surfaces of the tool parts 11a, 11b to cause expansion (moving apart) of the tool parts 11a, 11b. The resilience of arms 11 biases the mandrel 15 to the closed position as the rod 16 moves in the direction of arrow B.

Outer tool arms 13 are movable toward and away from one another under the influence of closing cam arms 20 of actuator 21 acting on a cam shoulder 13c of respective arms 13. Movement of actuator 21 in the direction of arrow D causes the external tooling parts 13a to be drawn toward one another. Movement of actuator 21 in the direction of arrow E causes the external tool parts 13a to relatively separate. Arms 13 and 11 of the outer tool arrangement and the inner mandrel are retained by cam support ring 22. The arms 11, 13 resiliently flex relative to the cam support ring 22 as the actuators 21, 16 operate.

The operation of the embossing tooling is such that the internal mandrel 15 is operable to expand and contract independently of the operation of the external tool parts 13a ..

The internal mandrel 15 (comprising arms 11) and the external tooling (comprising arms 13) connected at cam support ring 22, are rotatable relative to table 6, in unison about the axis of mandrel 15. Bearings 25 are provided for this purpose. A servo-motor (or stepping motor) 26 is connected via appropriate gearing to effect controlled rotation of the tooling 10 relative to table 6 in a manner that will be explained in detail later.

With the tooling 10 in the position shown in figure 11, the mandrel 15 is expanded by moving actuator rod 16 in the direction of arrow A causing the internal tooling parts 11a to lie against the internal circumferential wall of cylinder 1, adopting the configuration shown in figures 12,

12a. Next actuator 21 moves in the direction of arrow D causing cam arms 20 to act on cam shoulder 13c and flexing arms 13 toward one another. In so doing the external tooling parts 13a engage the cylindrical wall of container 1, projections 14 deforming the material of the container 1 wall into respective complementary receiving formations 12 on the internal tooling parts 11a. An important feature is that the internal tooling parts 11a support the non deforming parts of the container wall during deformation to form the embossed pattern 50. At this stage in the procedure, the situation is as shown in figures 13, 13a. The configuration and arrangement of the cam arms 20, cam shoulders 13c of the external embossing tooling and the sloping (or wedge) cam surface of internal tooling parts 11a (cooperating with the cam head 17 of rod 16) provides that the embossing force characteristics of the arrangement can be controlled to ensure even embossing over the entire area of the embossed pattern 50. The external cam force action on the outer tool parts 13a is rearward of the embossing formations 14; the internal cam force action on the inner tool parts 11a is forward of the embossing formations 12. The forces balance out to provide a final embossed pattern of consistent depth formations over the entire zone of the embossed pattern 50.

Next actuator 21 returns to its start position (arrow E) permitting the arms 13 of the external toling to flex outwardly to their normal position. In so doing tooling parts 13a disengage from embossing engagement with the container 1 external surface. At this stage in the procedure, the situation is as shown in figures 14, 14a.

The next stage in the procedure is for the internal mandrel to collapse, moving tooling parts 11a out of abutment with the internal wall of the cylinder 1. At this stage in the procedure, the situation is as shown in figures 15, 15a.

Finally the tooling table 6 is retracted away from the rotatable table 3 withdrawing the tooling 10 from the container. At this stage in the procedure, the situation is as shown in figures 16, 16a.

The rotary table is the indexed rotationally moving the embossed container to adjacent with the next tooling station 7, and bringing a fresh container into alignment with the embossing tooling 10 at station 9.

The embossing stages described correspond to stages 106 to 112 in the flow diagram of figure 1.

Prior to the approachment of the embossing tooling 10 to a container 1 clamped at table 3 (Figure 11 and stage 106 of figure 1) it is important that the container 1 and tooling 10 are accurately rotationally oriented to ensure that the embossed pattern 50 is accurately positioned with respect to the printed design on the exterior of the container.

According to the present invention this is conveniently achieved by reviewing the position of a respective container 1 whilst already securely clamped in a chuck 4 of the rotary table 3, and rotationally reorientating the embossing tooling 10 to the required position. This technique is particularly convenient and advantageous

because a rotational drive of one arrangement (the embossing tooling 10) only is required. Chucks 4 can be fixed relative to the table 3 and receive containers in random axial rotational orientations. Moving parts for the apparatus are therefore minimised in number, and reliability of the apparatus is optimised.

The open ends 8 of undeformed containers 1 approaching the apparatus 2 have margins 30 printed with a coded marking band 31 comprising a series of spaced code blocks or strings 32 (shown most clearly in figure 4). Each code block/string 32 comprises a column of six data point zones coloured dark or light according to a predetermined sequence.

With the container 1 clamped in random orientation in a respective chuck 4 a charge coupled device (CCD) camera 60 views a portion of the code in its field of view. The data corresponding to the viewed code is compared with the code band data stored in a memory (of controller 70) for the coded band and the position of the can relative to a datum position is ascertained. The degree of rotational realignment required for the embossing tooling 10 to conform to the datum for the respective container is stored in the memory of a main apparatus controller 70. When the respective container 10 is indexed to face the embossing tooling 10 the controller instigates rotational repositioning of the tooling 10 to ensure that embossing occurs at the correct zone on the circumferential surface of the container 1. The controller 70 when assessing the angular position of the tooling relative to the angular

position to be embossed on the container utilises a decision making routine to decide whether clockwise or counterclockwise rotation of the tooling 10 provides the shortest route to the datum position, and initiates the required sense of rotation of servo-motor 26 accordingly. This is an important feature of the system in enabling rotation of the tooling to be effected in a short enough time-frame to be accommodated within the indexing interval of the rotating table 3.

The coding block 32 system is in effect a binary code and provides that the CCD camera device can accurately and clearly read the code and determine the position of the container relative to the tooling 10 datum by viewing a small proportion of the code only (for example two adjacent blocks 32 can have a large number of unique coded configurations). The coding blocks 32 are made up of vertical data point strings (perpendicular to the direction of extent of the coding band 31) in each of which there are dark and light data point zones (squares). Each vertical block 32 contains six data point zones. This arrangement has benefits over a conventional bar code arrangement, particularly in an industrial environment where there may be variation in light intensity, mechanical vibrations and like.

As can be seen in figure 4, because the tooling 10 in the exemplary embodiment is arranged to emboss the same pattern at 180 degree spacing, the coding band 31 includes a coding block pattern that repeats over 180 degree spans.

The position determination system and control of rotation of the tooling 10 are represented in blocks 102 to 105 of the flow diagram of figure 5.

The coding band 31 can be conveniently printed contemporaneously with the printing of the design on the exterior of the container. Forming of the neck to produce, for example a valve seat 39 (figure 3) obscures the coding band from view in the finished product.

Claims:

1. A method of relative orientation of a body (typically a container or generally cylindrical body) and associated apparatus, the method comprising sampling a portion of a coded region of the body, comparing the sampled code portion to memory stored code data, determining the orientation correction to reorientate the relative position of the cylindrical body and the associated apparatus to a datum situation.

2. A method according to claim 1, wherein the coded region of the body comprises a code carrying zone comprising one or more code strings each code string comprising a plurality of data points, the data points indicating one or other of contrasting data indicia.

3. A method according to claim 2, wherein a plurality of code strings are provided in side by side relationship.

4. A method according to claim 3, wherein adjacent data code strings comprise one or more adjacently corresponding data points having contrasting data indicia.

5. A method according to claim 3 or claim 4, wherein the code strings extend generally in the longitudinal direction of the cylindrical body.

6. A method according to any preceding claim, wherein the coded region of the cylindrical body comprises a band extending over the outer surface of the cylindrical body.

7. A method according to claim 6, wherein the band extends proximate an open end of a container.

8. A method according to any of claims 2 to 7, wherein contrasting data points are of light shade and dark shade.

9. A method according to any of claims 2 to 8, wherein the or each data code string includes four or more data points.

10. A method according to claim 9, wherein the or each data code string includes six or more data points.

11. A method according to any preceding claim, wherein the coded region extends through at least substantially 180 degrees about the axis of the cylindrical container.

12. A method according to any preceding claim, wherein the coded region extends through substantially 360 degrees about the axis of the cylindrical container.

13. A method according to any preceding claim, wherein the coded region is sampled using optical means.

14. A method according to claim 13, wherein the coded region is sampled using camera means.

15. A method according to any preceding claim, wherein the coded region is sampled using CCD camera means.

16. A method according to any preceding claim, wherein the relative position of the cylindrical body and the associated apparatus is reorientated to a datum situation.

17. A method according to claim 16, wherein the associated apparatus tooling is for marking or deforming the external wall of the cylindrical body, the tooling being reorientated (preferably rotationally) relative to the cylindrical body.

18. A method according to any preceding claim, wherein reorientation correction is capable of being reorientation in a clockwise or anticlockwise sense.

19. A method according to claim 18, wherein the shortest route to datum situation reorientation correction either clockwise or anticlockwise is determined and/or selected.

20. A container or generally cylindrical body having a coded region comprising one or more code strings, a code string comprising a plurality of data points, the data points indicating one or other of contrasting data indicia.

21. A container or generally cylindrical body according to claim 20, wherein a plurality of code strings are provided in side by side relationship.

22. A container or generally cylindrical body according to claim 21, wherein adjacent data strings comprise one or more adjacently corresponding data points having contrasting data indicia.

23. A container or generally cylindrical body according to claim 21 or claim 22, wherein the code strings extend generally in the longitudinal direction of the cylindrical body.

24. A container or generally cylindrical body according to any of claims 20 to 23, wherein the coded region of the cylindrical body comprises a band extending over the outer surface of the cylindrical body.

25. A container or generally cylindrical body according to claim 24, wherein the band extends proximate an open end of the body.

26. A container or generally cylindrical body according to any of claims 20 to 25, wherein contrasting data points are of light shade and dark shade.

27. A container or generally cylindrical body according to any of claims 20 to 26, wherein the or each code string includes four or more data points.

28. A container or generally cylindrical body according to claim 27, wherein the or each code string includes six or more data points.

29. A container or generally cylindrical body according to any of claims 20 to 28, wherein the coded region extends through at least substantially 180 degrees about the axis of the cylindrical container.

30. A container or generally cylindrical body according to any of claims 20 to 29, wherein the coded region extends through substantially 360 degrees about the axis of the cylindrical container.

31. A re-orientation system for co-ordination of a body (such as a container or cylindrical body) and associated body processing apparatus, the system comprising:

a sampling arrangement for sampling a coded region of the body; and

a processor arranged to process sampled code data comparing to memory stored code data and produce a correction output to re-orientate the body and body processing apparatus to a datum situation.

32. A system according to claim 31 configured to operate according to the method of any of claims 1 to 19.

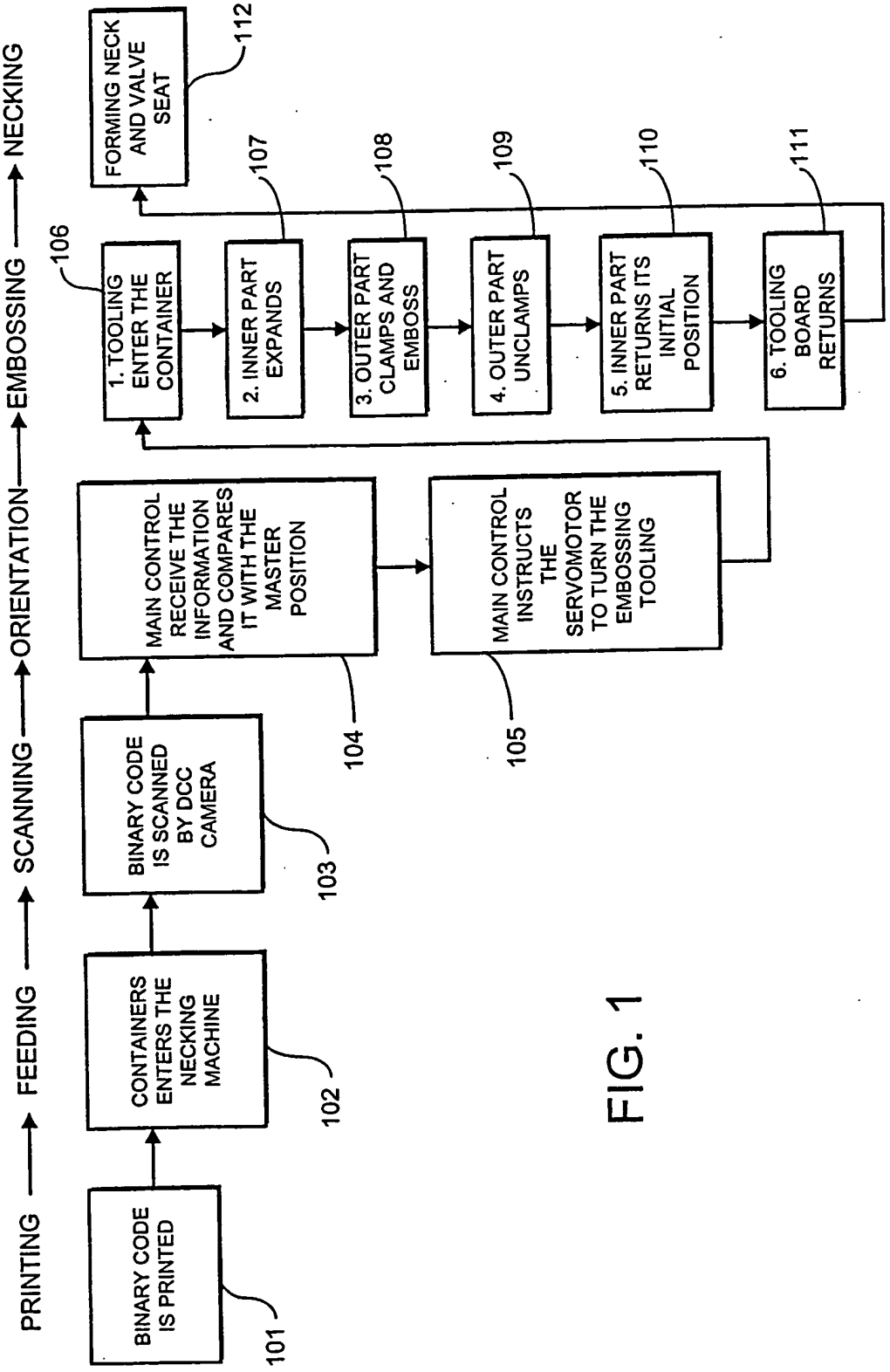

PRINTING
FEEDING
SCANNING
ORIENTATION
EMBOSSING
NECKING
BINARY CODE IS PRINTED
101
CONTAINERS ENTERS THE NECKING MACHINE
102
BINARY CODE IS SCANNED BY DCC CAMERA
103
MAIN CONTROL RECEIVE THE INFORMATION AND COMPARES IT WITH THE MASTER POSITION
104
MAIN CONTROL INSTRUCTS THE SERVOMOTOR TO TURN THE EMBOSSING TOOLING
105
106
1. TOOLING ENTER THE CONTAINER
2. INNER PART EXPANDS
107
3. OUTER PART CLAMPS AND EMBOSS
108
4. OUTER PART UNCLAMPS
109
5. INNER PART RETURNS ITS INITIAL POSITION
110
6. TOOLING BOARD RETURNS
111
FORMING NECK AND VALVE SEAT
112

FIG. 1

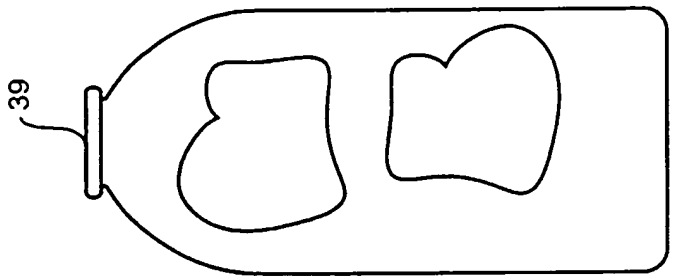


FIG. 3

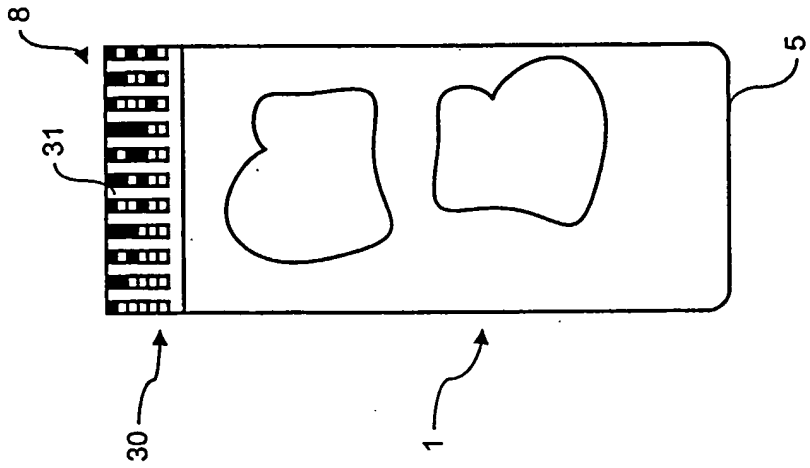


FIG. 2

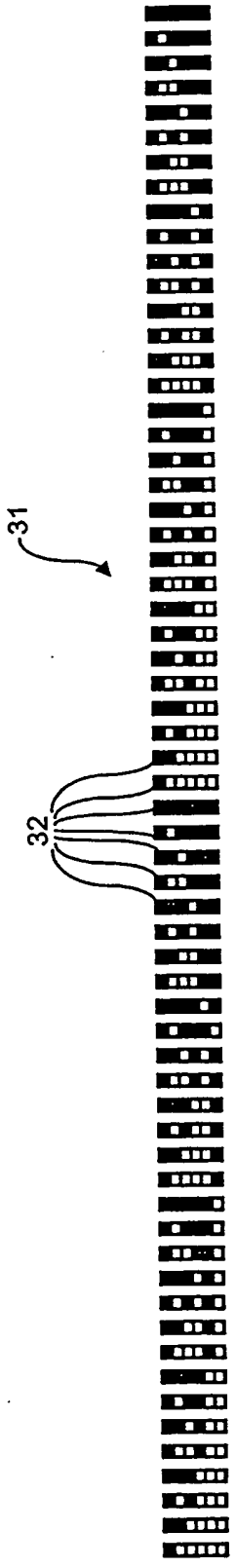


FIG. 4

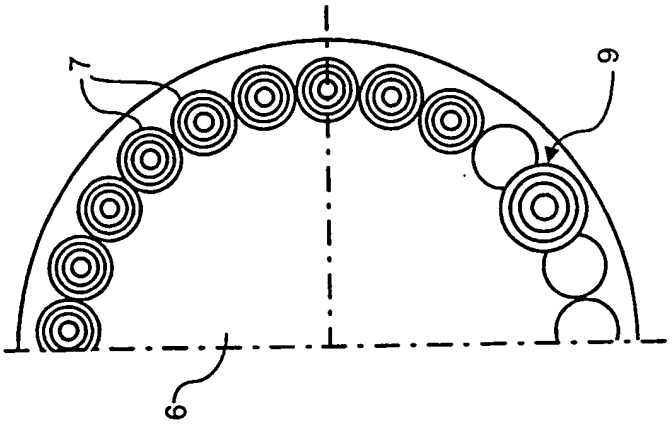


FIG. 7

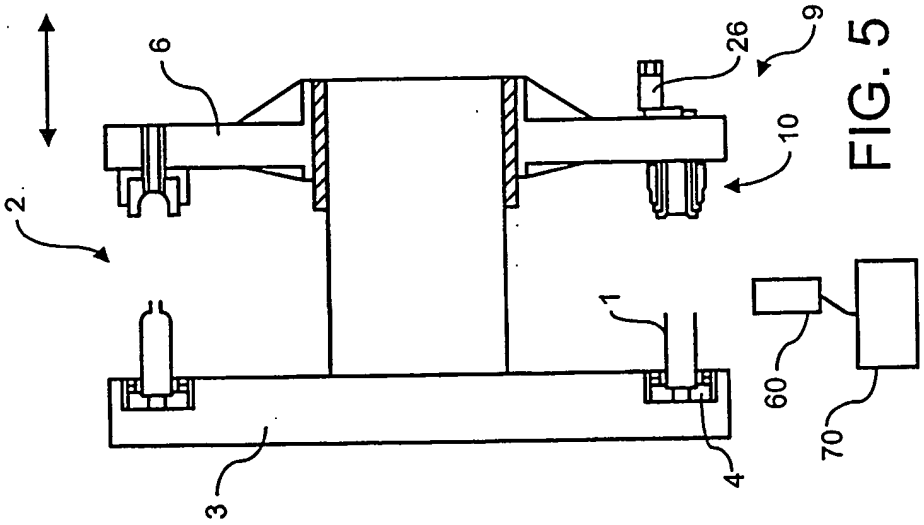


FIG. 5

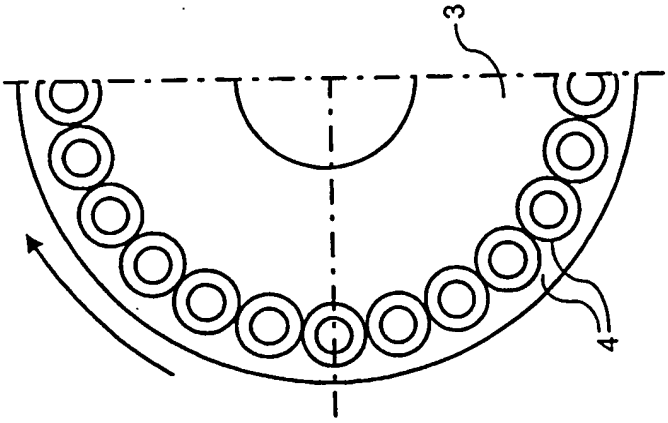


FIG. 6

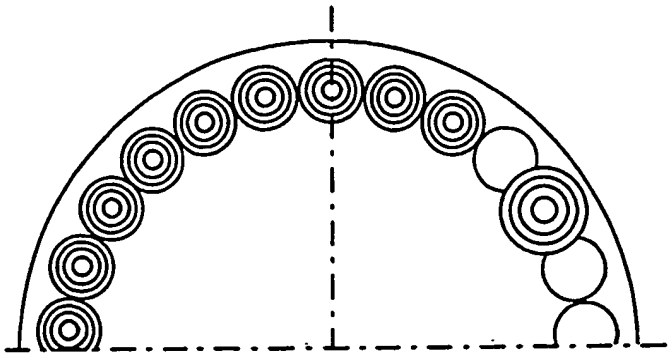


FIG. 10

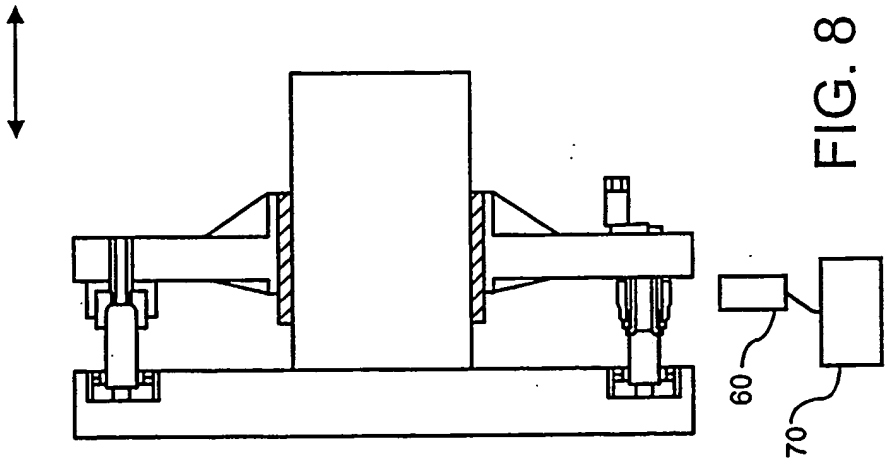


FIG. 8

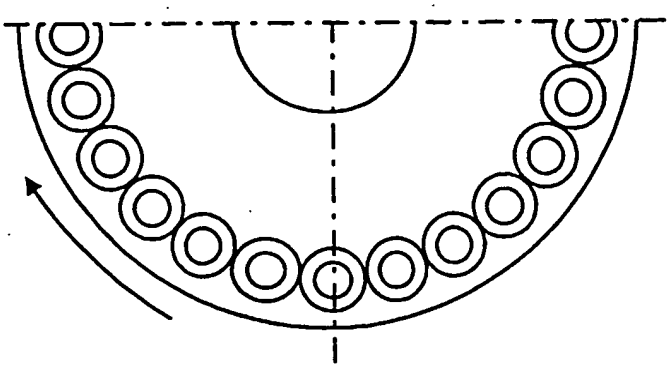


FIG. 9

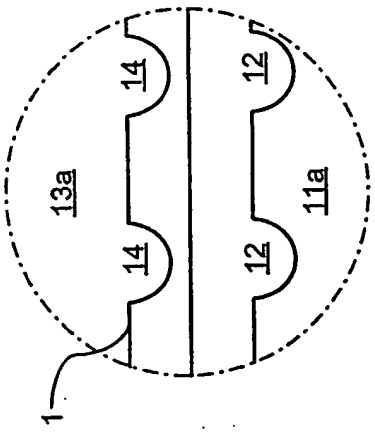


FIG. 11a

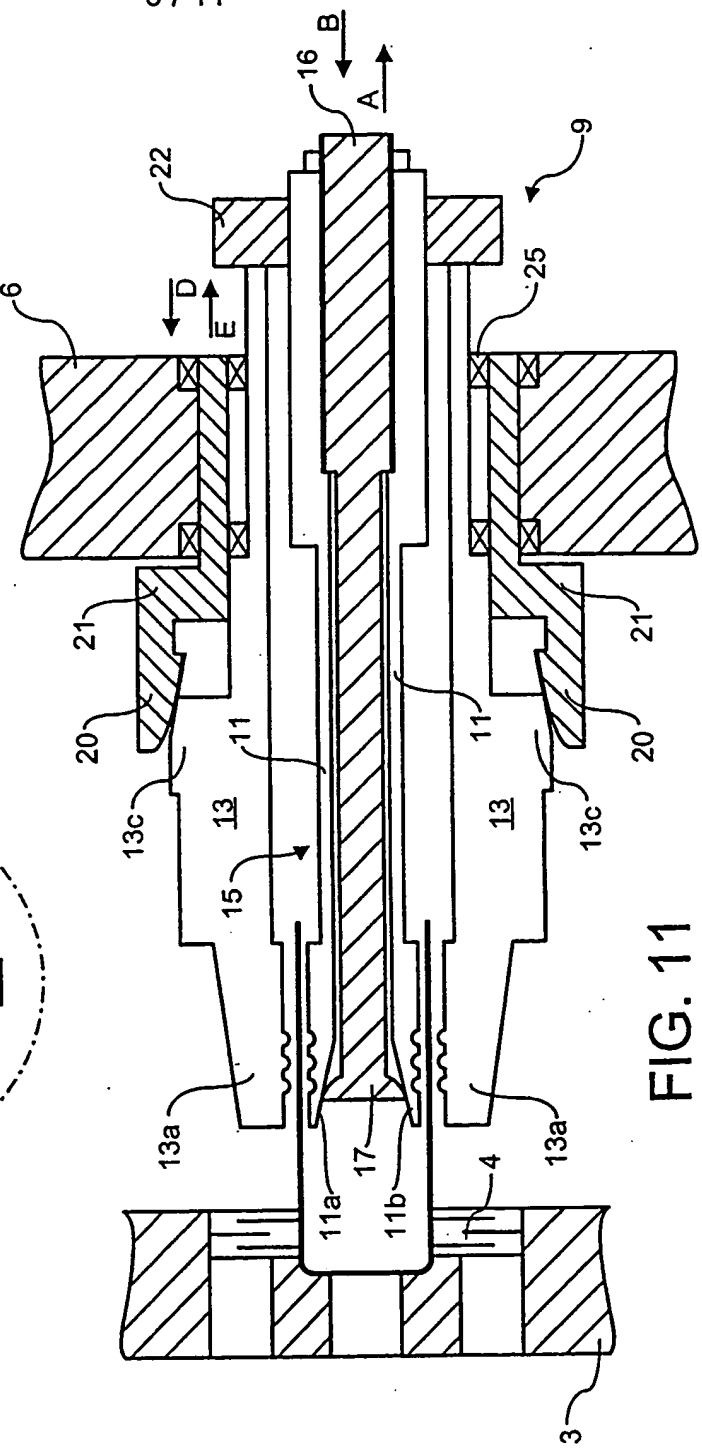


FIG. 11

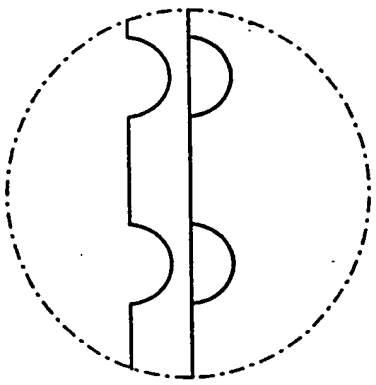


FIG. 12a

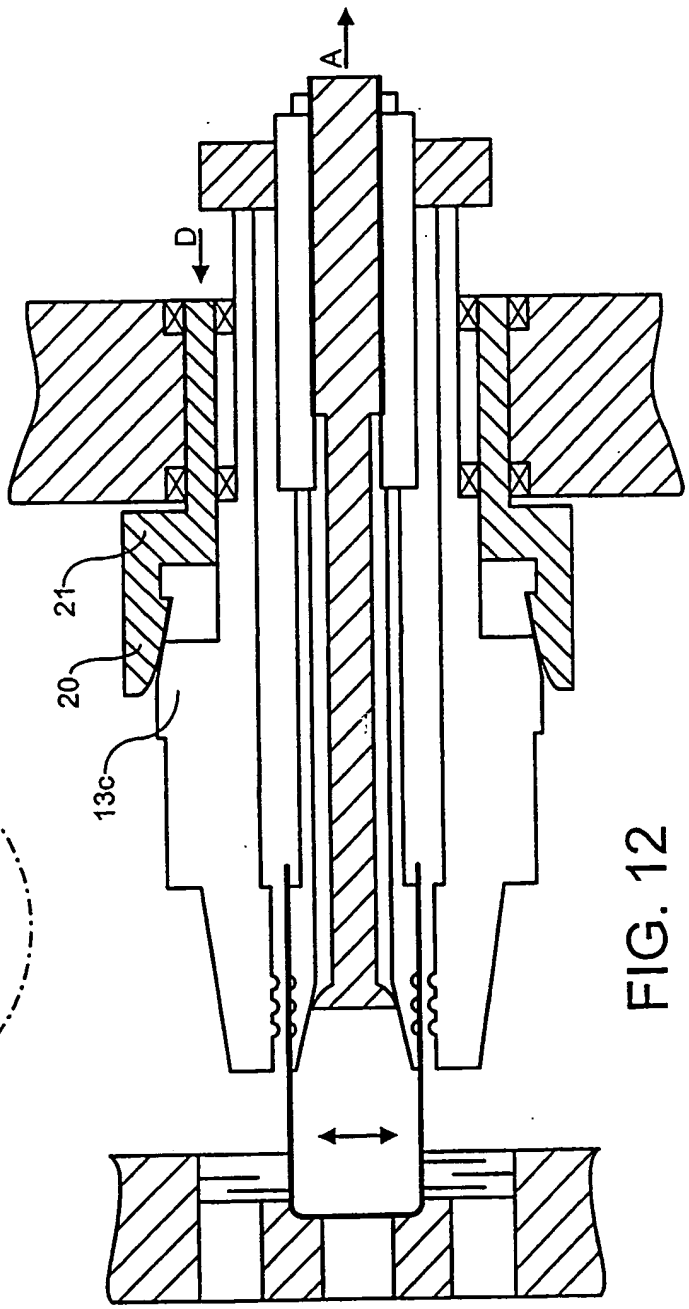
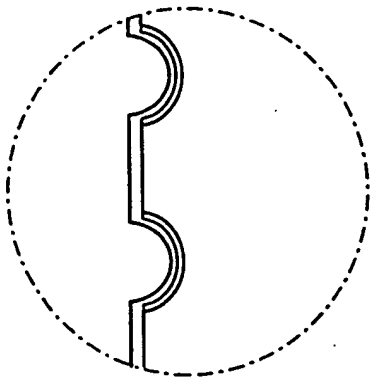


FIG. 12

FIG. 13a



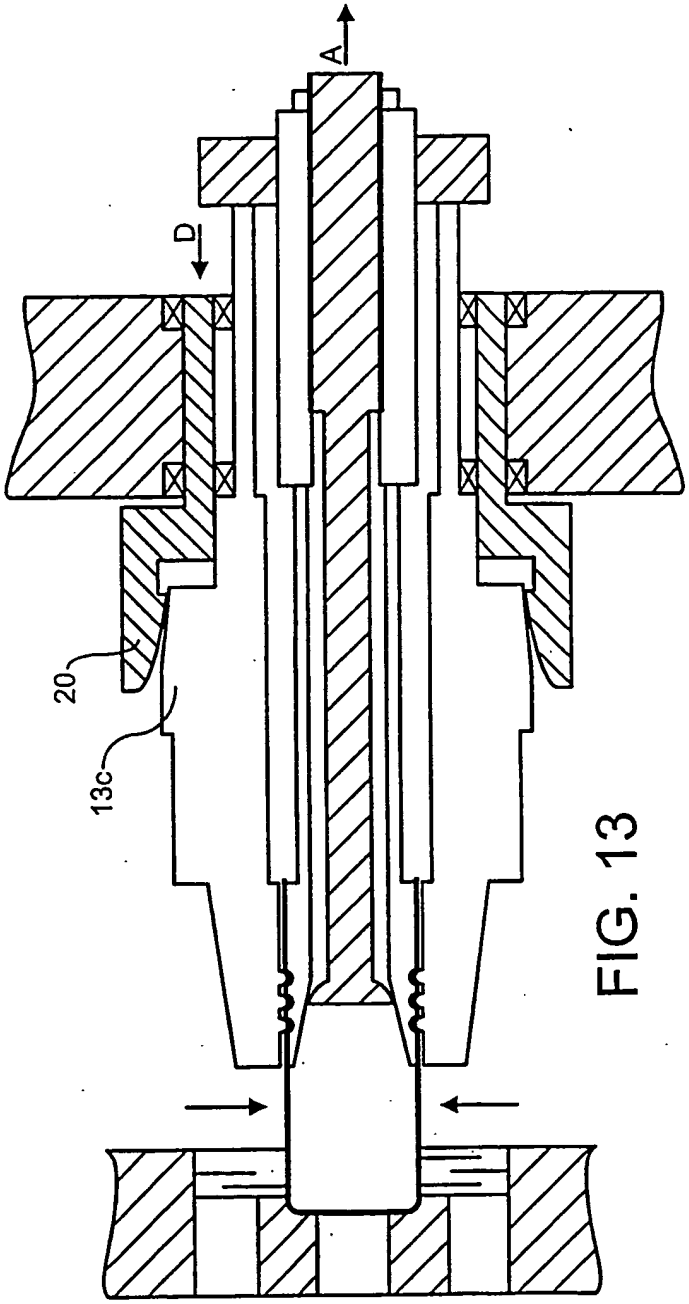
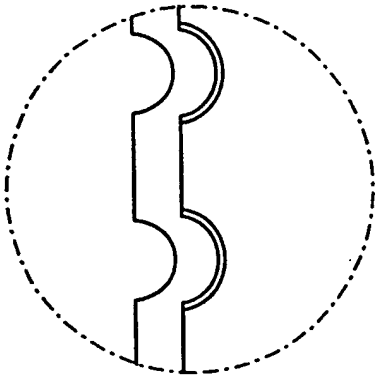


FIG. 13

FIG. 14a



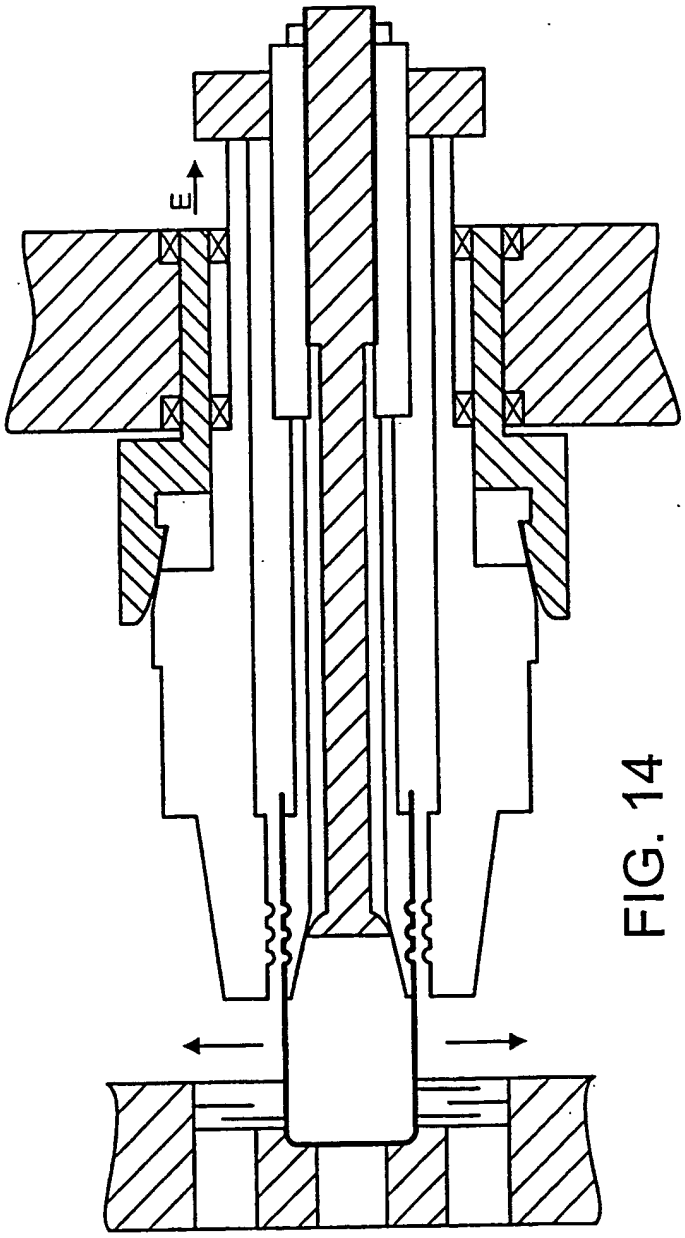
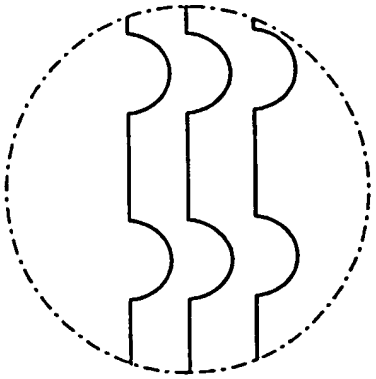


FIG. 14

FIG. 15a



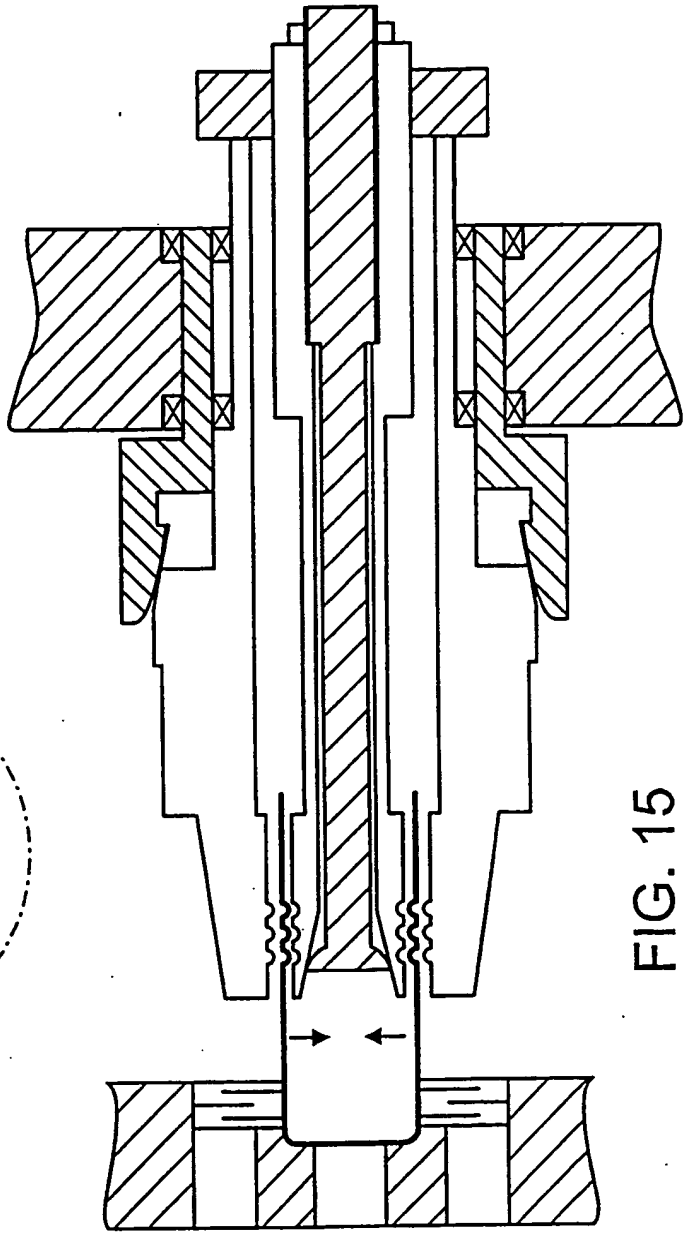


FIG. 15

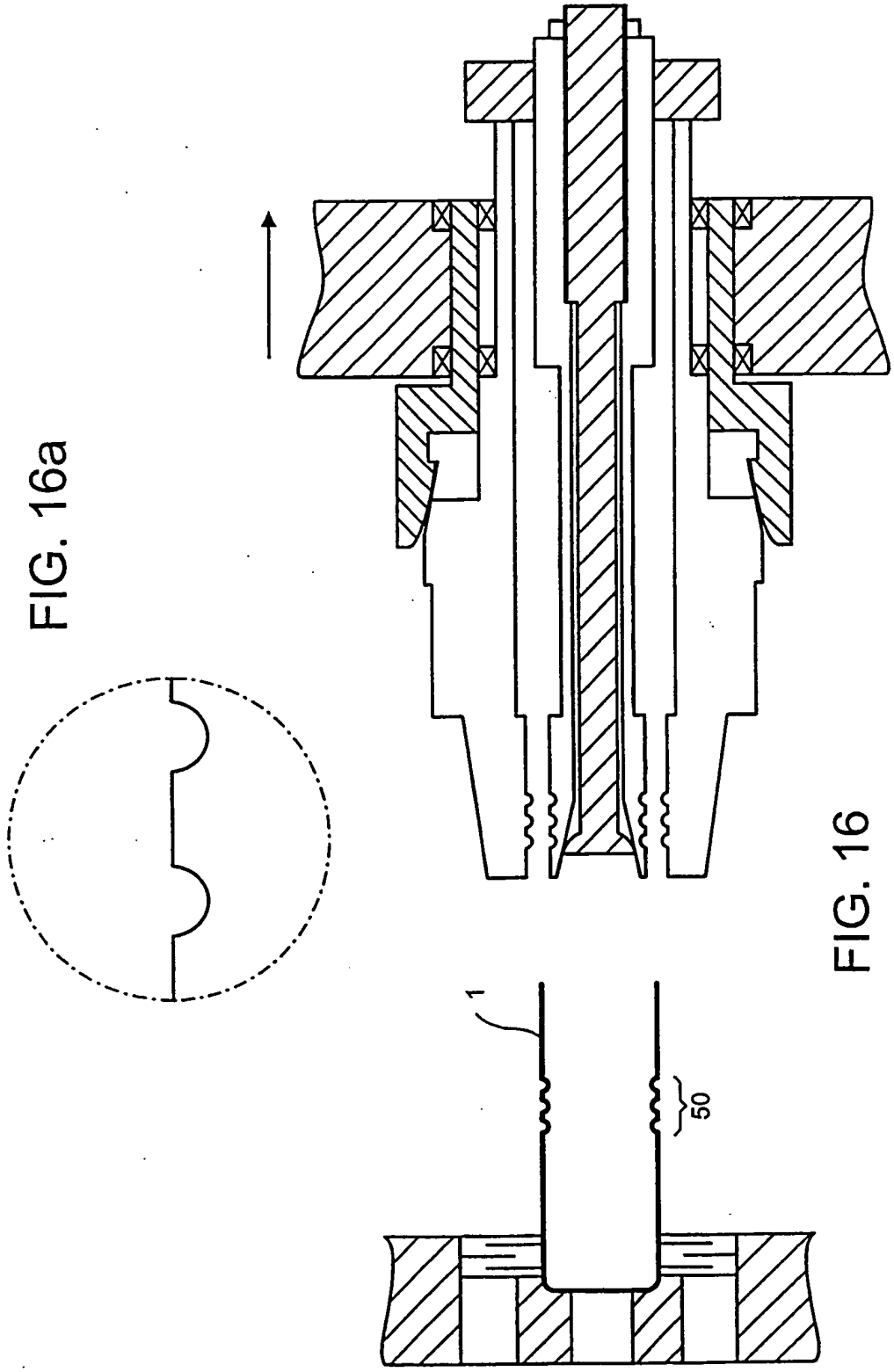


FIG. 16a

FIG. 16

INTERNATIONAL SEARCH REPORT

Ir ional Application No
PCT/GB 01/00534

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B65C9/06 B65G47/244 B21D51/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B65C B65G B21D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 97 21505 A (METAL BOX PLC ;CARNAUDMETALBOX SA (FR); CARNAUDMETALBOX NV (NL); C) 19 June 1997 (1997-06-19) page 9, line 23 -page 15, line 9; claims 1,5,6,12; figures 1-6	1-32
X	US 5 941 109 A (ELLIS LARRY W ET AL) 24 August 1999 (1999-08-24) column 6, line 7 -column 7, line 16; claims 1-4	1-32

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 June 2001	22/06/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Vinci, V

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
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